04738168 **Image available**

CERAMIC MULTILAYERED BOARD

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ABSTRACT

PURPOSE: To obtain a ceramic multilayerd board wherein high level integration and high density constitution are possible, generation of cracks can be avoided by improving transverse rupture strength, resistance characteristics are enhanced, and the application as a circuit board can be enlarged.

CONSTITUTION: A ceramic multilayered board 1 is constituted by unifying an alumina substrate part 2 and a low temperature sintered substrate part 3 into one body interposing thermosetting resin 16 (insulating member). The pattern of an electric circuit 4 is formed on the alumina substrate part 2, and a passive element 10 is formed in the inside of the low temperature sintered substrate part 3. The passive element 10 is electrically connected with the electric circuit 4 via land electrodes 5, 12.

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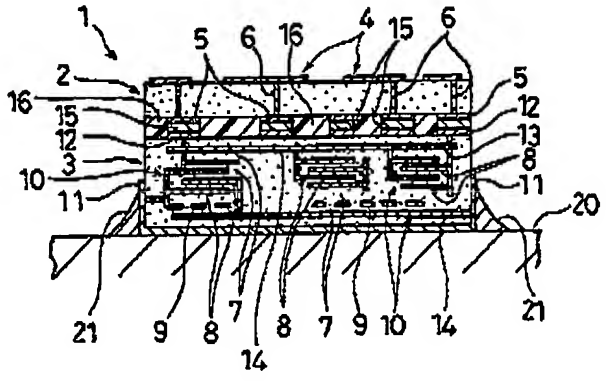
(54)【発明の名称】セラミック多層基板

(57)【要約】

【目的】　回路配線の高集積化，高密度化に対応でき、かつ抗折強度を向上してクラックの発生を回避できるとともに、抵抗特性を向上でき、ひいては回路基板としての用途を拡大できるセラミック多層基板を提供する。

【構成】　上記アルミナ基板部２と低温焼結基板部３とを熱硬化樹脂１６（絶縁部材）を介在させて一体化することによりセラミック多層基板１を構成する。そして上記アルミナ基板部２に電極回路４をパターン形成するとともに、上記低温焼結基板部３の内部に受動素子１０を形成する。また該受動素子１０と上記電極回路４とをランド電極５，１２を介して電気的に接続する。



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【特許請求の範囲】

【請求項1】　絶縁部材を介在させて一体化された少なくとも一対のアルミナ基板部と低温焼結基板部とからなり、上記アルミナ基板部に電極回路をパターン形成するとともに、上記低温焼結基板部の内部に受動素子を形成し、該受動素子と上記電極回路とを上記両基板部を介して電気的に接続したことを特徴とするセラミック多層基板。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、高集積化，高密度化に対応できるとともに、抗折強度，抵抗特性を向上でき、ひいては回路基板としての用途を拡大できるようにしたセラミック多層基板に関する。

【0002】

【従来の技術】電子機器，電子部品を構成する回路基板として、従来から混成集積回路や多層基板等が採用されている。この混成集積回路は、アルミナ基板の表面に酸化ルテニウム系の抵抗ペーストを用いて抵抗，配線等の電極回路を厚膜状にパターン形成してなるもので、これはレンジで10Ω／b～10MΩ／b，TCRで±150ppmと優れた抵抗特性が得られる。また、上記多層基板は、低温焼結のセラミック材料と電極とを交互に積層して同時に一体焼結し、これによりコンデンサ，インダクタ等の受動素子を内蔵してなるもので、小型で高集積化，高密度化に優れた特長を有している。

【0003】

【発明が解決しようとする課題】しかしながら、上記従来の混成集積回路では、電極回路の多層化がアルミナ基板の両面合わせても6層程度が限界であることから、高集積化，高密度化に対応できないという問題がある。また、上記従来の多層基板では、電極回路の多層化には対応できるものの、低温焼結セラミック材料を用いることから抗折強度が低く、取り扱い時やトリミング時等にクラックが生じ易いという問題がある。さらにまた上記低温焼結セラミック材料に表面抵抗を形成して再加熱する場合、抵抗との界面状態が不安定となり易いことから、抵抗特性に劣るという問題点がある。この結果、上記従来の混成集積回路，多層基板ではそれぞれ用途が限定されることから、この点での改善が要請されている。

【0004】本発明は上記従来の状況に鑑みてなされたもので、電極回路の多層化を可能にして高集積化，及び高密度化に対応でき、かつ抗折強度を向上してクラックの発生回避できるとともに、抵抗特性を向上でき、ひいては回路基板としての用途を拡大できるセラミック多層基板を提供することを目的としている。

【0005】

【課題を解決するための手段】本発明は、絶縁部材を介在させて一体化された少なくとも一対のアルミナ基板部と低温焼結基板部とからなり、上記アルミナ基板部に電極回路をパターン形成するとともに、上記低温焼結基板部の内部に受動素子を形成し、該受動素子と上記電極回路とを上記両基板部を介して電気的に接続したことを特徴とするセラミック多層基板である。

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【0006】ここで、上記受動素子と電極回路とを接続するには、両基板部の対向面にランド電極を形成し，該各ランド電極と受動素子，及び電極回路とをスルーホール電極，側面電極を介して接続し、上記ランド電極同士を半田バンプ、導電ペイント，あるいは厚膜ペーストで加熱接合することにより実現できる。また、上記両基板部を一体化するには，両基板の間に絶縁性の熱硬化樹脂，あるいはガラスペースト等を塗布し、これを所定温度で加熱することにより両基板部を接合できる。

【0007】

【作用】本発明に係るセラミック多層基板によれば，アルミナ基板部と低温焼結基板部とを一体形成したので、この低温焼結基板部で回路配線の多層化を可能にでき、高集積化，高密度化に対応できる。また抗折強度の高いアルミナ基板部を一体化したので、低温焼結基板部の抗折強度を向上でき、取り扱い時等におけるクラックの発生を回避できる。さらに上記アルミナ基板部に抵抗を形成することにより再加熱による特性劣化を回避でき、抵抗特性を向上できる。この結果、1つの部品素子で，高集積化，高密度化に対応でき、かつ抗折強度及び抵抗特性を向上できることから、それだけ回路基板としての用途を拡大でき、上述の要請に応えられる。

【0008】

【実施例】以下，本発明の実施例を図について説明する。図1ないし図3は本発明の一実施例によるセラミック多層基板を説明するための図である。図において，1は本実施例の特徴をなすセラミック多層基板であり、これはアルミナ基板部2と低温焼結基板部3とから構成されている。上記アルミナ基板部2は、90～99％アルミナを含むセラミックシートを高温焼成して形成されたもので、この基板部2の上面にはAg，Ag／Pd，Ag／Pt，Cuからなる電極回路4がパターン形成されている。この電極回路4は抵抗，配線を厚膜状に形成してなり、この配線にトランジスタやダイオード等のチップ部品が接続される。

【0009】また上記アルミナ基板部2の下面には同じくAg／Pd，Cuからなるランド電極5がパターン形成されており、この各ランド電極5と上記電極回路4の入出力部とは基板部2を貫通して形成されたスルーホール電極6により接続されている。

【0010】上記低温焼結基板部3は、$BaO-Al_2O_3-SiO_2$系セラミック材料からなるセラミック層7を多数枚積層して構成されている。また各セラミック層7の上面にCu，Agからなるコンデンサ電極8，及びスパイラル状のコイル電極9をパターン形成し、このコイル電極9，及び各コンデンサ電極8とセラミック層7

とを交互に積層して積層体を形成し、この積層体を１０００℃以下の低温で同時に一体焼結して形成されたものである。これにより上記低温焼結基板部３の内部にはコンデンサ，インダクタからなる受動素子１０が形成されている。

【００１１】また上記低温焼結基板部３の外表面には表面実装用の端子電極１１，１１が形成されており、該端子電極１１には上記各受動素子１０の入出力部が接続されている。

【００１２】上記低温焼結基板部３の上面にはランド電極１２がパターン形成されており、この各ランド電極１２は上記アルミナ基板部２の各ランド電極５と対向している。上記各ランド電極１２とコンデンサ電極８，コイル電極９の入出力部とは基板部３内に形成されたスルーホール電極１３，共通電極１４を介して接続されている。

【００１３】また上記低温焼結基板部３の各ランド電極１２とアルミナ基板部２の各ランド電極５とは高温半田１５により電気的に接続されている。これは上記低温焼結基板部３の各ランド電極１２上面に高温半田パンプ１５をスクリーン印刷等より塗布し、この半田パンプ１５を２８０～３３０℃で加熱することにより上記各ランド電極５，１２同士を接合したものである。ここで、上記パンプ材には、上記高温半田１５の他にろう材，導電ペイント，厚膜金属ペーストを採用でき、これらをスクリーン印刷，あるいはディスペンサで塗布してもよい。上記ろう材を用いる場合の加熱温度は３５０～８００℃、導電ペイントの場合には２００～５００℃、さらに厚膜ペーストの場合は４５０～９００℃で行うこととなる。

【００１４】そして、上記アルミナ基板部２と低温焼結基板部３との間には絶縁性の熱硬化樹脂１６が充填されており、この樹脂１６を介して上記両基板部２，３は機械的に一体化されている。これは上記低温焼結基板部３のランド電極１２を除く表面に熱硬化樹脂１６を塗布し、該樹脂１６と上記高温半田１５とを同時に加熱して接合したものである。ここで、上記熱硬化樹脂１６の他に、ガラスペーストを用いてもよい。

【００１５】次に本実施例の作用効果について説明する。本実施例のセラミック多層基板１を製造するには、アルミナ基板部３，及び低温焼結基板部３にそれぞれ別個に電極回路４，受動素子１０を形成する。次に低温焼結基板部３の各ランド電極１２に高温半田パンプ１５を塗布するとともに、該基板部３のランド電極１２を除く上面に熱硬化樹脂１６を塗布する。そしてこの低温焼結基板部３の上面にアルミナ基板部２を配設するとともに、該基板部２の各ランド電極５と上記ランド電極１２とを位置合わせして固定する。

【００１６】この状態で所定温度に加熱することによって、両基板部２，３のランド電極５，１２同士を電気的に接合し、該基板部２，３同士を機械的に接合する。これによりアルミナ基板部２，低温焼結基板部３が一体化したセラミック多層基板１を形成する。そしてこのセラミック多層基板１は、これをプリント基板２０上に載置し、該基板２０のラインと端子電極１１とを半田２１で接続して実装される。

【００１７】このように本実施例によれば、セラミック多層基板１をアルミナ基板部２と低温焼結基板部３とを一体化して構成したので、上記低温焼結基板部３で受動素子１０を内蔵できるとともに回路配線を多層化でき、高集積化，高密度化に対応できる。また、抗折強度の高いアルミナ基板部２と低温焼結基板部３とを一体化したので、低温焼結基板部３の抗折強度を向上でき、取り扱い時のクラック等の発生を回避でき、品質に対する信頼性を向上できる。さらに、上記アルミナ基板部２に抵抗を形成することにより、優れた抵抗特性が得られることから、従来の低温焼結材料では困難であった再加熱による特性劣化を回避できる。

【００１８】このように本実施例セラミック多層基板１では、高集積化，高密度化に対応でき、かつ抗折強度，抵抗特性を向上できることから、上記アルミナ基板部２，低温焼結基板部３を用途に応じて構成することにより、あらゆる回路製品に対応でき、モジュール基板として用途を拡大できる。

【００１９】また、アルミナ基板２と低温焼結基板部３とを一体化したので、低温焼結セラミック材料単体で多層配線を構成する場合に比べて電気的な回路結合を回避でき、それだけ回路設計の自由度を向上できる。さらにまたアルミナ基板部２，低温焼結基板部３をそれぞれ別個に焼成したので、両基板部を結合する際に不良品の選別を行うことができ、信頼性を向上できる。

【００２０】なお、上記実施例では、アルミナ基板部２，低温焼結基板部３をそれぞれ１枚用いてセラミック多層基板１を構成した場合を例にとって説明したが，本発明は上記何れか一方の基板部，又は両方の基板部を複数枚用いてもよい。また上記アルミナ基板部にはこれの上面，下面に電極回路と絶縁層とを交互に積層した構造のものを採用してもよい。

【００２１】

【発明の効果】以上のように本発明に係るセラミック多層基板によれば、アルミナ基板部と低温焼結基板部とを絶縁部材を介して一体化し、上記アルミナ基板部の電極回路と低温焼結基板部内の受動素子とを電気的に接続したので、回路配線の多層化を可能にして高集積化，高密度化に対応でき、かつ抗折強度を向上してクラックの発生を回避できるとともに、抵抗特性を向上できる効果があり、ひいては回路基板としての用途を拡大できる効果がある。

【図面の簡単な説明】

【図１】本発明の一実施例によるセラミック多層基板を説明するための断面図である。

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【図２】上記実施例のアルミナ基板部と低温焼結基板部とを接合する状態を示す分解斜視図である。

【図３】上記実施例のセラミック多層基板の一部拡大断面図である。

【符号の説明】

１　セラミック多層基板

２　アルミナ基板部

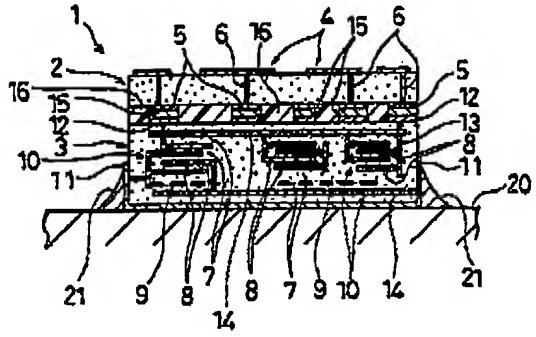
３　低温焼結基板部

４　電極回路

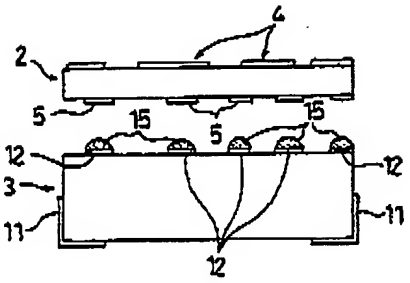
１０　受動素子

１６　熱硬化樹脂（絶縁部材）

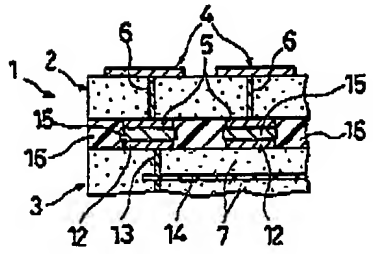
【図１】



【図２】



【図３】



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(54) [Title of the Invention] MULTILAYER CERAMIC BOARD

(57) [Abstract]

[Object] To provide a ceramic multilayer board which can respond to high integration and densification of a circuit wiring, prevent crack generation by improving transverse rupture strength, improve a resistance characteristic, and thus expand its use as a circuit board.

[Constitution] A multilayer ceramic board 1 is formed by integrating the alumina substrate portion 2 with a low-temperature sintered substrate portion 3 with a thermosetting resin 16 (insulating member) interposed therebetween. An electrode circuit is formed on the alumina substrate portion 2 by patterning, and a passive element 10 is formed inside the low-temperature sintered substrate portion 3. In addition, the passive element 10 is electrically connected to the electrode circuit 4 through land electrodes 5 and 12.

[Scope of Claim for Patent]

[Claim 1] A multilayer ceramic board comprising at least a set of an alumina substrate portion and a low-temperature sintered substrate portion which are integrated with each other with an insulating member interposed therebetween,

wherein an electrode circuit is formed on the alumina substrate portion by patterning, a passive element is formed inside the low-temperature sintered substrate portion, and the passive element is electrically connected to the electrode circuit through both of the substrate portions.

[Detailed Description of the Invention]

[0001]

[Field of Industrial Application] The present invention relates to a multilayer ceramic board which can respond to high integration and densification, improve transverse rupture strength and a resistance characteristic, and thus expand its use as a circuit board.

[0002]

[Prior Art] A hybrid integrated circuit, a multilayer board, or the like has been conventionally employed as a circuit board included in an electronic device or an electronic component. This hybrid integrated circuit is made by forming an electrode circuit such as a resistor or a wiring on a surface of an alumina substrate by patterning using a resistive paste based on ruthenium oxide so as to be thick. It can provide a superior resistance characteristic in the range of 10 Ω/b to 10 MΩ/b with TCR of ± 150 ppm. Further, the multilayer board is formed by alternately laminating a low-temperature sintered ceramic material and an electrode and simultaneously sintering them in an integrated manner. Accordingly, it incorporates a passive element such as a capacitor or an inductor, and it is small and has superior characteristics for high integration and densification.

[0003]

[Problems to be Solved by the Invention] However, the conventional hybrid integrated circuit has a problem in that it cannot respond to high integration and densification since multilayering of an electrode circuit is limited to as many as approximately six layers

even as a total on both sides of the alumina substrate. Although the conventional multilayer board can respond to the multilayering of the electrode circuit, it has a problem in that transverse rupture strength thereof is low and a crack tends to be generated at the time of handling, trimming, or the like because of using the low-temperature sintered ceramic material. In addition, it has a problem of being inferior in a resistance characteristic since, in the case of forming a surface resistor on the low-temperature sintered ceramic material and then reheating it, an interface with the resistor tends to be unstable. Accordingly, each use of the conventional hybrid integrated circuit and multilayer board is limited. Therefore, improvement in this regard has been requested.

[0004] The present invention is made in view of the above conventional situation, and it is an object of the invention to provide a multilayer ceramic board which can respond to high integration and densification by making multilayering of an electrode circuit possible, prevent crack generation by improving transverse rupture strength, improve a resistance characteristic, and thus expand its use as a circuit board.

[0005]

[Means to Solve the Problem] The invention is a multilayer ceramic board comprising at least a set of an alumina substrate portion and a low-temperature sintered substrate portion which are integrated with each other with an insulating member interposed therebetween, wherein an electrode circuit is formed on the alumina substrate portion by patterning, a passive element is formed inside the low-temperature sintered substrate portion, and the passive element is electrically connected to the electrode circuit through both of the substrate portions.

[0006] Here, the passive element can be connected to the electrode circuit by forming land electrodes on opposing faces of both substrate portions, connecting each land electrode to the passive element and the electrode circuit through a through-hole electrode and a side electrode, and heat-joining the land electrodes to each other with a solder bump, a conductive paint, or a thick-film paste. In order to integrate both of the substrate portions with each other, both substrate portions can be joined to each other by applying an insulating thermosetting resin, a glass paste, or the like between both substrates and then heating it at a predetermined temperature.

[0007]

[Operation] Since the alumina substrate portion and the low-temperature sintered substrate portion are formed in an integrated manner, the multilayer ceramic board according to the invention makes multilayering of a circuit wiring possible in this low-temperature sintered substrate portion and can respond to high integration and densification. In addition, since the low-temperature sintered substrate portion is integrated with the alumina substrate portion having high reverse rupture strength, the multilayer ceramic board can improve transverse rupture strength of the low-temperature sintered substrate portion and prevent crack generation at the time of handling or the like. Further, by forming a resistor in the alumina substrate portion, characteristic deterioration due to reheating can be prevented and a resistance characteristic can be improved. Accordingly, the multilayer ceramic board can respond to high integration and densification and improve transverse rupture strength and a resistance characteristic with one component element. Therefore, it can correspondingly expand its use as a circuit board to meet the above-described request.

[0008]

[Embodiment] An embodiment of the invention is explained with reference to the drawings. FIGS. 1 to 3 are diagrams for explaining a multilayer ceramic board according to one embodiment of the invention. In the drawings, reference numeral 1 denotes a multilayer ceramic board constituting a characteristic of this embodiment, which includes an alumina substrate portion 2 and a low-temperature sintered substrate portion 3. The alumina substrate portion 2 is formed by baking at a high temperature a ceramic sheet containing alumina of 90 % to 99 %, and an electrode circuit 4 of Ag, Ag/Pd, Ag/Pt, and Cu is formed on the upper surface of the substrate portion 2 by patterning. This electrode circuit 4 is made by forming a resistor and a wiring to be thick, and a chip component such as a transistor or a diode is connected to the wiring.

[0009] Land electrodes 5 of Ag/Pd and Cu are formed on the lower surface of the aluminum substrate portion 2 by patterning. Each land electrode 5 is connected to an input/output portion of the electrode circuit 4 with a through-hole electrode 6 which is formed to penetrate the substrate portion 2.

[0010] The low-temperature sintered substrate portion 3 is formed by laminating many ceramic layers 7 of a ceramic material based on BaO-Al_2O_3-SiO. In addition, a capacitor electrode 8 of Cu and Ag and a spiral coil electrode 9 are formed by patterning on the upper surface of the respective ceramic layers 7, and the coil electrode 9, the capacitor electrodes 8 and the ceramic layers 7 are alternately laminated to form a laminate, and the laminate is simultaneously sintered in an integrated manner at a low temperature of 1000 °C or less. Accordingly, passive elements 10 including a capacitor and an inductor are formed inside the low-temperature sintered substrate portion 3.

[0011] In addition, terminal electrodes 11 and 11 for surface mounting is formed on an outer surface of the low-temperature sintered substrate portion 3, and an input/output portion of each passive element 10 is connected to the terminal electrode 11.

[0012] Land electrodes 12 are formed on the upper surface of the low-temperature sintered substrate portion 3 by patterning, and each land electrode 12 is opposed to each land electrode 5 of the alumina substrate portion 2. Each land electrode 12 is connected to an input/output portion of the capacitor electrode 8 or the coil electrode 9 through a through-hole electrode 13, a common electrode 14 formed in the substrate portion 3.

[0013] Each land electrode 12 of the low-temperature sintered substrate portion 3 is electrically connected to each land electrode 5 of the alumina substrate portion 2 with a high-temperature solder 15. The land electrode 5 and the land electrode 12 are joined to each other by applying the high-temperature bump 15 to the upper surface of each land electrode 12 of the low-temperature sintered substrate portion 3 by screen printing or the like and then heating the solder bump 15 at 280 °C to 330 °C. Here, a brazing material, a conductive paint, or a thick-film metal paste other than the high-temperature solder 15 can be employed as a material of the bump and may be applied by screen printing or a dispenser. The heating is performed at 350 °C to 800 °C in the case of using the brazing material, at 200 °C to 500 °C in the case of the conductive paint, and at 450 °C to 900 °C in the case of the thick-film paste.

[0014] A space between the alumina substrate portion 2 and the low-temperature sintered substrate portion 3 is filled with an insulating thermosetting resin 16, and both of the substrate portions 2 and 3 are mechanically integrated with each other with the resin

16 interposed therebetween. This joining is performed by applying the thermosetting resin 16 to a surface of the low-temperature sintered substrate portion 3 except the land electrode 12 and then simultaneously heating the resin 16 and the high-temperature solder 15. Here, a glass paste other than the thermosetting resin 16 may be used.

[0015] Next, an operation and an effect of this embodiment are explained. In order to manufacture the multilayer ceramic board 1 of this embodiment, the alumina substrate portion 3 and the low-temperature sintered substrate portion 3 are separately provided with the electrode circuit 4 and the passive element 10, respectively. Subsequently, the high-temperature solder bump 15 is applied to each land electrode 12 of the low-temperature sintered substrate portion 3, and the thermosetting resin 16 is applied to the upper surface of the substrate portion 3 except the land electrode 12. Then, the alumina substrate portion 2 is located over the upper surface of the low-temperature sintered substrate portion 3, and is fixed with each land electrode 5 of the substrate portion 2 aligned to the land electrode 12.

[0016] By heating in this state to a predetermined temperature, the land electrodes 5 and 12 of both substrate portions 2 and 3 are electrically joined to each other, and the substrate portions 2 and 3 are mechanically joined to each other. Accordingly, the multilayer ceramic board 1 is formed in which the alumina substrate portion 2 is integrated with the low-temperature sintered substrate portion 3. Then, the multilayer ceramic board 1 is placed over a printed board 20 and mounted thereon by connecting a line of the board 20 to the terminal electrode 11 with a solder 21.

[0017] According to this embodiment as described above, the multilayer ceramic board 1 is formed by integrating the alumina substrate portion 2 with the low-temperature sintered substrate portion 3. Therefore, the low-temperature sintered substrate portion 3 can incorporate the passive element 10, a circuit wiring can be multilayered, and high integration and densification can be responded to. In addition, the alumina substrate portion 2 having high transverse rupture strength is integrated with the low-temperature sintered substrate portion 3. Therefore, transverse rupture strength of the low-temperature sintered substrate portion 3 can be improved, generation of a crack or the like can be prevented at the time of handling, and quality reliability can be improved.

Further, a superior resistance characteristic can be obtained by providing the alumina substrate portion 2 with a resistor. Therefore, characteristic deterioration due to reheating, which has been difficult to prevent with a conventional low-temperature sintered material, can be prevented.

[0018] As described above, the multilayer ceramic board 1 of this embodiment can respond to high integration and densification and improve transverse rupture strength and a resistance characteristic. Therefore, it can respond to all circuit products and expand its use as a module board by forming the alumina substrate portion 2 and the low-temperature sintered substrate portion 3 depending on its use.

[0019] In addition, since the alumina substrate 2 and the low-temperature sintered substrate portion 3 are integrated with each other, electrical circuit coupling can be prevented as compared to the case of forming a multilayer wiring with a low-temperature sintered ceramic material alone. Correspondingly, a degree of freedom of circuit design can be improved. Further, since the alumina substrate portion 2 and the low-temperature sintered substrate portion 3 are separately baked, a defective product can be sorted out at the time of coupling both substrate portions, thereby improving reliability.

[0020] Note that, although the case of forming the multilayer ceramic board 1 using one alumina substrate portion 2 and one low-temperature sintered substrate portion 3 is taken as an example to explain the above-described embodiment, either one of the substrate portions or both of the substrate portions may be pluralized. In addition, one having a structure in which an electrode circuit and an insulating layer are alternately laminated on the upper and lower surface thereof may be employed as the alumina substrate portion.

[0021]

[Effect of the Invention] Since an alumina substrate portion and a low-temperature sintered substrate portion are integrated with each other with an insulating member interposed therebetween and an electrode circuit of the alumina substrate portion is electrically connected to a passive element in the low-temperature sintered substrate portion, a multilayer ceramic board according to the invention can respond to higher integration and densification by making multilayering of a circuit wiring possible and prevent crack generation by improving transverse rupture strength, and has the effect of

improving a resistance characteristic and thus expanding its use as a circuit board.

[Brief Description of Drawing]

[FIG. 1] A cross-sectional view to explain a multilayer ceramic board according to one embodiment of the invention.

[FIG. 2] An exploded perspective view showing a state in which the alumina substrate portion and the low-temperature sintered substrate portion of the above-described embodiment are joined to each other.

[FIG. 3] A partially enlarged sectional view of the multilayer ceramic board of the above-described embodiment.

[Explanation of Reference]

1	Multilayer ceramic board
2	Alumina substrate portion
3	Low-temperature sintered substrate portion
4	Electrode circuit
10	Passive element
16	Thermosetting resin (Insulating member)